Qualification Accredited

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Exemplar Candidate Work

COMPUTER SCIENCE

H446
For first teaching in 2015

H446/01 Summer 2019 series

Version 1

Contents

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Introduction

These exemplar answers have been chosen from the summer 2019 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but they do illustrate how the mark scheme has been applied.

Please always refer to the specification https://www.ocr.org.uk/Images/170844-specification-accredited-a-level-gce-computer-science-h446.pdf for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2019 Examiners' report or Report to Centres available from Interchange https://interchange.ocr.org.uk

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2020. Until then, they are available on OCR Interchange (school exams officers will have a login for this and are able to set up teachers with specific logins – see the following link for further information https://www.ocr.org.uk/administration/support-and-tools/interchange/ managing-user-accounts/).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.

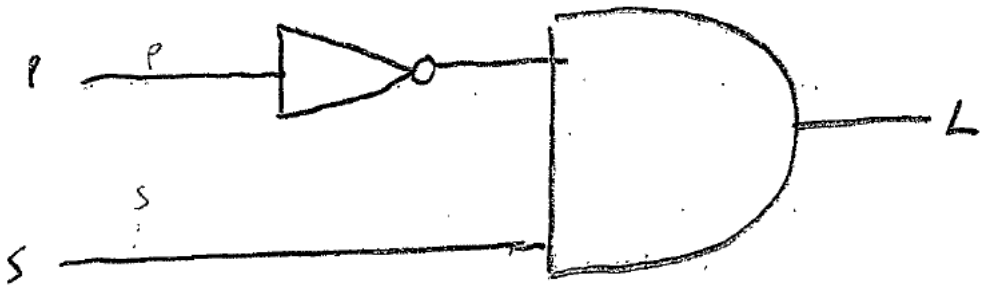
Question 1(c)(ii)

(c) Bertie Butler's circuitry is designed to only listen out for "Hey Bertie" under certain circumstances, which are:

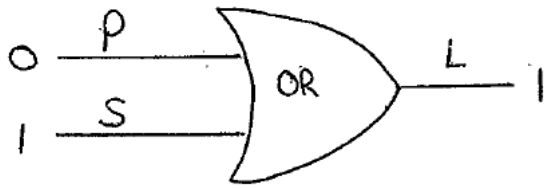
The privacy button (**P**) must be off and the microphone must generate a signal (**S**) to say a sound has been heard.

(ii) Draw logic gates to represent the circuitry needed. **[3]**

Exemplar 1 — 3 marks



Exemplar 2 — 0 marks



Examiner commentary

To gain full marks on this question, the candidate response should very clearly show the correct diagrammatic representation of the appropriate gates to meet the mark scheme criteria, see Exemplar 1.

The main reason that some candidates did not score well on this question was for using incorrect gates i.e. many used an OR gate instead of an AND gate as shown in Exemplar 2.

Candidates should also take time to draw the gates very clearly following the specification appendix 5d Boolean Algebra guidance, these are the only acceptable representations. The examiner should not be left in any doubt which gate the candidate is representing in their diagram.

Question 2(d)

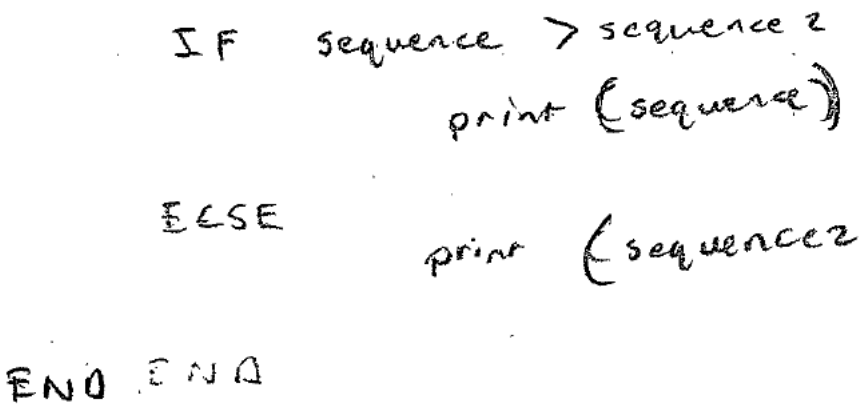
(d) Write the function `longest` which takes in a string of characters as an argument and returns an integer representing the longest continuous sequence of Cs. **[5]**

Exemplar 1 — 5 marks

```
function longest(sequence)
    ~~for~~ maxCounter = 0
    counter = 0
    for index = 0 to sequence.length - 1 do
        if sequence[index] == "C" then
            counter = counter + 1
        else then
            if counter > maxCounter then
                maxCounter = counter
            end if
            counter = 0
        end if
    next index
    return maxCounter
end function.
```

Exemplar 2 — 1 mark

```
function longest ( characters )
sequence = 0
    For x = 0 to len(characters) - 1 :

        If characters(x) == characters(x+1)

            sequence = sequence + 1

            x = x + 1
            z = x
        ELSE characters(z) != characters(z+1)

        FOR z to len(characters) - 1 :

            IF characters(z) == characters(z+1)
                sequence 2 = 0
                Sequence 2 = sequence 2 + 1

            z = z + 1
```



[5]

Examiner commentary

When candidates are asked to write a function at this level of study, the minimum expectation is that the function returns a value. In addition, if the question states that the function 'takes …' a value then, the response is expected to show a parameter being passed. Although most candidates would understand that a loop is required to iterate the 'sequence' in this question, it is important that the solution iterates the correct number of times. For example, in a FOR loop with a lower bound of 0, the upper bound must be: length of sequence -1.

Candidates should be reminded to read the question carefully. Some coded the solution to check for the largest sequence of any letter not just C as the question asked see Exemplar 2.

Candidates should also remember to always reset any totals where necessary in the loop. Exemplar 1 met all of these criteria and therefore scored full marks.

Question 4(d)

(d) Explain the advantages and disadvantages of owning films that are streamed or downloaded on demand rather than owning a physical copy. **[4]**

Exemplar 1 — 4 marks

Some advantages are: No physical media to ~~scratch~~ scratch or damage, as you can re-aquire a copy if the downloaded file is corrupted or lost. You can own a much longer number of films without taking up physical space. Some disadvantages are: you need an internet connection to stream or download the films, and for slow connections this may be too slow. The device you are downloading the film to need to have enough free storage. **[4]**

Exemplar 2 — 0 marks

The advantages are is that it's a lot easier to obtain a film digitally and it also allows cross platform viewing across multiple devices which means a user can watch wherever they go. The downsides is that qualities of a film can depend on network speeds whereas a dvd will always be the same quality. And piracy is another big problem as illegal digital copies of films can be distributed losing the film makers profit. **[4]**

Examiner commentary

Some candidate responses to this question were generally either too vague to gain credit or not unique in this context. When explaining advantages and disadvantages, candidates must support their assertions. For example, many candidate cited an advantage being that 'films can be accessed from anywhere' without going on to say 'with an internet connection'. The advantage given in Exemplar 2 although it alludes to the requirement of an internet connection it does not state 'needing an internet connection', 'network' is not an acceptable alternative.

The 'piracy' disadvantage given in Exemplar 2 is not unique to films streamed/downloaded on demand, it could also apply to physical copies.

Exemplar 1 gives two clearly explained and easily identifiable advantages and disadvantages unique to streamed/downloaded films and therefore gained full marks.

Question 4(e)

Being able to stream high resolution films is only possible due to improvements in compression.

(e) Explain why compression is important for the streaming of high resolution films. **[3]**

Exemplar 1 — 0 marks

To reduce the file size of the film. High resolution films will be of a large file size so in order to minimise the file size, any redundant data should be removed.

Exemplar 2 — 3 marks

Very large files such as high quality movies must be compressed to reduce their file size and hence enable users to stream them in real time over internet connections. Without compression, high quality video cannot be streamed on slower internet connections as the files size is too big. By compressing, less buffering is needed to stream high quality films. This makes high quality available to more people. Bandwidth of streaming will not be exceeded if files are compressed as they can be reproduced fully on the users side when received. **[3]**

Examiner commentary

Candidates were required in this question to explain **why** compression is important when streaming high resolution films. Many candidates instead, explained **what** compression is. Candidates must address the actual question being asked at this level of study, hence, applying their knowledge to the given scenario.

In Exemplar 1, the candidate has correctly said that compression reduces the size of the file but they have not then gone on to say why this is important when streaming i.e. 'therefore reducing the amount of data which needs to be sent…'.

Exemplar 2 has offered three valid reasons why compression is important when streaming high resolution films i.e. '…can be streamed in real-time…with less buffering…bandwidth will not be exceeded. Therefore achieving full marks.

Question 5(c)

(c) Complete the function `hash` which takes in a string and returns the hashed value.

You can assume you have access to the following three functions.

- `asc()` – this takes in a character and returns its ASCII value. For example `asc("A")` returns 65.
- `locate()` – this takes in a string and character and returns the location of the first instance of the character (with the string starting at character 0). For example `locate("electricity","c")` returns 3.
- `upper()` – this takes in a string and returns the UPPERCASE version. For example `upper("hello")` returns "HELLO".

You should also assume that all given website names use letters but no numbers or symbols.

You will be given credit for the readability of your code.

```
function hash(siteName)
```

[5]

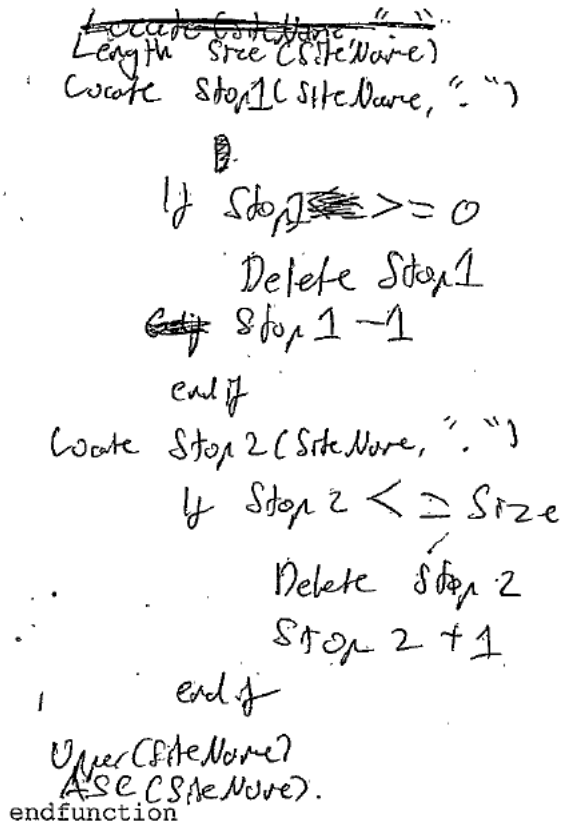
Exemplar 1

5 marks

```
Key = ""
First = locate(siteName, ".") + 1
Key = SiteName.Substring(First, len(siteName)-First))
Second = locate(Key, ".")
Key = Key.Substring(0, Second)
Key = upper(Key)
total i = 0 ... (Key) -1
for i from 0 to len(Key)-1
    total = total + asc(Key.Substring(i,1))
next i
return Total
end function
```

Exemplar 2

0 marks



Examiner commentary

This question gives three functions, with very clear explanations as to what they do. It is clear from the description and example of the locate() function that it uses a zero based index. Since the position of the characters in the 'siteName' is vital to the solution, the manipulation of the index is key. It would therefore be advisable to urge candidates to use any functions given in the question.

When candidates choose to use language specific functions instead of those given in the question, they must demonstrate a very clear understanding as to whether the function uses a zero based or a one based index and correctly manipulate the index accordingly.

Candidates scored well on this question if they demonstrated understanding that they were required to appropriately add/subtract one from the current character position to exclude the 'dot' see Exemplar 1.

Regardless of whether the candidate correctly removed/discounted the appropriate characters, they could still access the marks for correctly converting the characters to upper case and correctly totalling the ASCII values.

In exemplar1, the candidate correctly returned a value from the function and passed the parameter. They correctly manipulated the index to remove characters up to and including the first dot, and including and after the second dot. Finally they totalled the ASCII values of all characters in the remaining string. Exemplar1 response received full marks.

In exemplar2, although the candidate eludes to the given functions, they are incorrectly used and there is no attempt to assign the returned values. In addition, there is no evidence of each character in the remaining siteName being converted or summed. This response therefore gained no credit.

Question 5(d)

A flaw with the current hash function is it tends to generate lots of collisions (addresses that compute to the same hash). Below is a diagram of part of the hash table. The address www.rnd.com with details `[2, true]` is being added to the hash table.

(d) Explain how a hash table can be used to handle collisions, referring to the example below.

227	
228	`www.ocr.org.uk : [1, true]`
229	
230	`www.ppf.nz : [2, false]`
231	
232	`www.ntf.biz : [4, true]`
234	
235	

[4]

Exemplar 1

4 marks

227	
228	www.ocr.org.uk : [1, true]
229	
230	www.ppf.nz : [2, false]
231	
232	www.ntf.biz : [4, true]
234	
235	

rnd
82 78 68

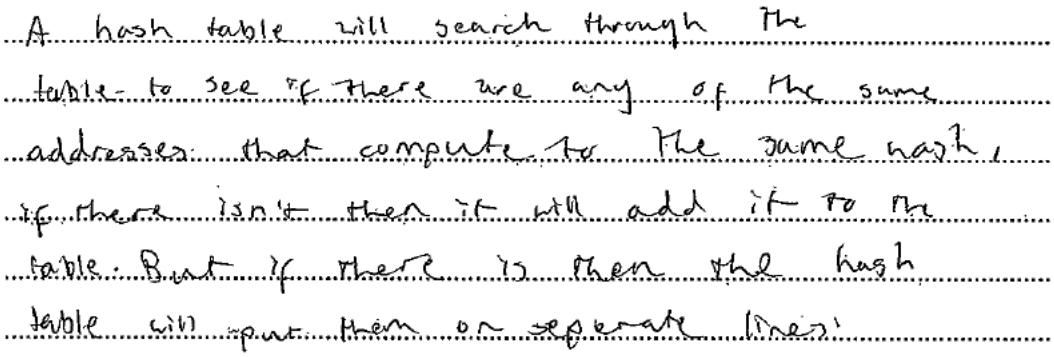
82
78
68
228

14+8=22

A hash table can handle hash collisions in two ways. Either by moving the ~~se~~ new value into the next free space, or by treating the spaces as a linked-list. "www.rnd.com" has a hash value of 228, which means there is a collision with @"www.ocr.org.uk". "www.rnd.com" could be stored in either 229, or in a linked list starting from 228. A hash table is normally constant time to access, but when there are collisions, a linear search must be ~~pef~~ ~~pef~~ performed as looking up the hash would give multiple items.

Exemplar 2

0 marks



Examiner commentary

When the question asks candidates to refer to a given example, they must cite appropriate aspects of the example in their response to support the points they are making to gain credit. In this case, candidates should demonstrate that they understand a collision occurs when www.rnd.com hashes to the same address as www.ocr.org.uk.

Some candidates explained how to better **avoid** collisions by changing the hashing algorithm rather than, as the question asked, how to **handle** collisions when they actually occurred.

Candidates scored well when they named or reasonably described Linear Probing, Chaining or use of an overflow area in their response. In exemplar1, the candidate has correctly demonstrated understanding of the collision in the example and reasonably described both Linear Probing and Chaining. Hence achieving full marks.

In exemplar2, the candidate has neither correctly explained how collisions are handled nor have they included an example. The candidate therefore achieved no marks for this response.

Question 5(e)

The hash function is changed so there are no longer high numbers of collisions.

During busy periods the firewall is expected to check several addresses a second. It is anticipated that roughly 10 new addresses will be added to a whitelist (list of acceptable addresses) each day.

There is a debate as to whether a hash table (with the new hash function) is the best approach, or if the whitelist would be better stored in a linked list.

(e) *Discuss whether a hash table or linked list is better to store acceptable websites. You should compare how each structure can be searched and has data added and come to a recommendation as to which is better for the whitelist. **[12]**

Exemplar 1 — 12 marks

A linked list is a dynamic data structure that has nodes which are connected via pointers. There is an order to the items in the list. This means that a linked list can only be searched linearly for values. Data is added by changing the pointers of nodes to insert and remove data. A hash table can be accessed immediately as the hash value of an input is the index in which it is stored. Data is added by using the hashing algorithm to find the index in which to store the value. The new algorithm reduces the number of collisions that occur. This makes the hash table much faster to search as ~~values are~~ most data is most likely to be in the position in which its hashed value points to. The process of adding data is therefore efficient and quick as only the ~~to~~ algorithm has to be applied. However, when collisions do occur, many problems arise as it has to decided how they are to be handled and where the data should be added to the table. Since 10 addresses are added to the whitelist each day, the hash table would be very effective as search times remain almost constant as the amount of data increases.

A linked can only be searched linearly and so searching for value takes longer and increases as the amount of data increases. This is not favourable for the ~~company~~ programmer as many data items are added each day. However, being dynamic means that ~~when~~ the linked list will adapt in size depending on incoming data and less storage is required. A hash table has ~~wasted~~ lots of empty data slots to maximise ~~efficiency and so~~ efficiency and so takes up more space.

Overall, a hash table is much better suited to the ~~company~~ programmers needs as it will remain efficient and fast to search as many websites are added to the whitelist each day. It also makes adding items much easier than in a linked list, given that the new hashing algorithm produces little collisions. Using a linked list will soon be very slow and not manageable as it increases by 10 items each day and has no indexing for searching.

Exemplar 2 — 1 mark

A hash table will ~~remove~~ break down the web address so that the site name is all that remains. This name is then turned into upper case and then calculates a hash value based on the sum of the ASCII values of each character. This is then stored in a hash table with all of the websites regarding a specific hash value. When checking a website to see if the user has the correct access level, it will firstly check the entire hash value to know which line of the table it is working from and then the value of each character in a site name to denote which website it is and ~~which~~ whether the user has the correct access level.

A linked list will check a website and assign it to the corresponding lists it can go into. So, for example, "www.our.org.uk : [1, true]" will be permitted to. This means it would have a one to many relationship. It will then check whether you are accessing it at the right time with your access level by linking all of the "true" websites together and then all of the "false" would be linked together since "true" and "false" are tags.

Overall, I would recommend using a linked list because there is no chance for collisions as each of the websites do not need to be stored as a value and you can easily load the list of the website as long as it is on your list depending on your user access level.

Examiner commentary

In these extended response questions candidates should attempt to address all aspects of the question in their response. It is advisable to encourage candidates to take a few minutes to plan the points they want to make before writing the response.

When marking this question, the examiner will read through the whole response to initially determine which band descriptors best describe the overall quality of the response, using a best fit approach.

Exemplar 1

In this case, the candidate demonstrates thorough knowledge and understanding of adding and searching data from hash tables and linked lists. The detail is generally accurate and detailed. The candidate has clearly applied their knowledge to the scenario and offered a supported judgement. This response is therefore a high level response.

How well the descriptors have been addressed will determine where in the band the candidate response lies. In this response the candidate has discussed and compared, according to the scenario, the fact that a hash table has direct access to data whereas a linked list has linear access. They have discussed the time complexity of both methods. They have reasoned the best approach given that 10 addresses will be added to the whitelist daily.

There is clear evidence of all qualities of the band descriptors being addressed, therefore the response was given the highest mark in the band.

It should be noted that the indicative content on the marks scheme (right hand column) indicates the expected parameters for candidate responses. As this response shows, a candidate response does not need to include all of the indicative content to achieve full marks.

Please see page nine of the mark scheme for further clarification.

Exemplar 2

In this case, the candidate demonstrates a lack of knowledge and understanding of adding and searching data from hash tables and linked lists. This response is therefore a low level response. The candidate did make a recommendation albeit misguided, this was deemed to be worthy of 1 mark.

Question 7(e)

The database previously stored reviews using the ASCII character set. ASCII uses 1 byte per character. It is decided to switch to the Unicode UTF-32 character set which uses 4 bytes per character.

(e) Give an advantage and disadvantage of changing character sets from ASCII to Unicode UTF-32. **[2]**

Exemplar 1 — 2 marks

Advantage A greater number of unique characters can be represented (greater than ASCII's 256).

Disadvantage More storage is required per character so the database will be larger.

Exemplar 2 — 1 mark

Advantage Other languages can add a review using Arabic, Chinese or Japanese etc characters. Globally available

Disadvantage Code takes up more Space and some characters eg. emojis may not be visible on some devices or software versions. **[2]**

Examiner commentary

Many candidates, as in Exemplar 1 achieved the advantage mark for correctly stating that 'more characters can be represented'. Fewer achieved the disadvantage mark because they stated that more 'space' instead of 'storage (space)' is required to store the review/each character. At this level of study, it is not acceptable for candidates to be using 'space' as an alternative for storage. Exemplar 2 demonstrates this.

Question 9

9* Discuss the positive and negative impacts computers are having on the environment. **[9]**

Exemplar 1 — 9 marks

Smart meters, automatic power saving. — Solar panels
land fill production ~~re~~ less need for paper.

21
Discuss the positive and negative impacts computers are having on the environment.

Computers can help with the environment but also cause damage to it.

For ~~(5)~~ negative aspects. Computers use electricity which is ~~usually~~ ~~go~~ mostly generated by fossil fules. These polute the environment and could contribute to global warming. This not only effects humans but can demage habitats. ~~The~~ In addition people's desire to get the latest technology means more computers are produced and their production uses up the earth's resources and polutes in doing so (during extraction and production). This desire ~~the~~ ~~re~~ increases the ammount of obsolete technology thrown away which is ~~non~~ non-recyclable and goes in the land fill. This can ruin parts of the land where they're stored.

The positives are as follows. With their computational power they can optimise renewable energies ~~as~~ meaning fossil fules are used less. For example they can make solar panels track the sun. Their introduction has meant ~~as~~ less paper is used for writing things up. This means fewer trees are felled and fewer habitats are destroyed. Finaly with these devices such as smart meters can help reduce the amount of fuel and energy used by the consumer - helping the environment. **[9]**

All in all, computers bring great posibilty for helping conserve the environment but more needs to be done to prevent waste.

Exemplar 2

3 marks

Discuss the positive and negative impacts computers are having on the environment.

One positive is that they can be used in order to record data such as any change in climate. This is important as it can monitor changes at all times and cannot include human error. Without a computer, a human could easily make mistakes when measuring the changes in the climate and wouldn't be able to constantly measure changes as they would need sleep. However, a disadvantage would be that computers are hard to dispose of and aren't always disposed of properly. This leads to more computers being stacked up in piles, thus ruining the climate and contributing towards pollution. A method of reducing this problem could be by instead of just throwing away old computers, you could donate them to charity shops. This means that the computer will have another owner, meaning that less computers need to be made and therefore, fewer computers are thrown away thus meaning that pollution is reduced. Overall, I would say that, as long as people don't create excess waste with them, computers are very positive for the environment as they can give more accurate readings when measuring things such as climate and pollution and can lead us to solutions in order to fix the issues we create.

Examiner commentary

Again with this extended response question, candidates should be encouraged to carefully plan their answer to cover all elements of the question.

Exemplar 1

In exemplar1, the candidate has demonstrated a thorough knowledge of the effect of computers on the environment. They have applied this knowledge with explicit and relevant positive and negative examples.

The response offers three positive impacts and three negative impacts which leads to a well-balanced discussion. The evaluative comments are well supported throughout. This response is clearly a high level response. The candidate was given full marks.

Again, the indicative content on the marks scheme (right hand column) indicates the expected parameters for candidate responses but examiners will credit any relevant content.

Many candidates offered a range of negative impacts in their response but then did not balance this with positive impacts which limited the credit given. Candidates should be reminded to make sure their response to this type of question is balanced.

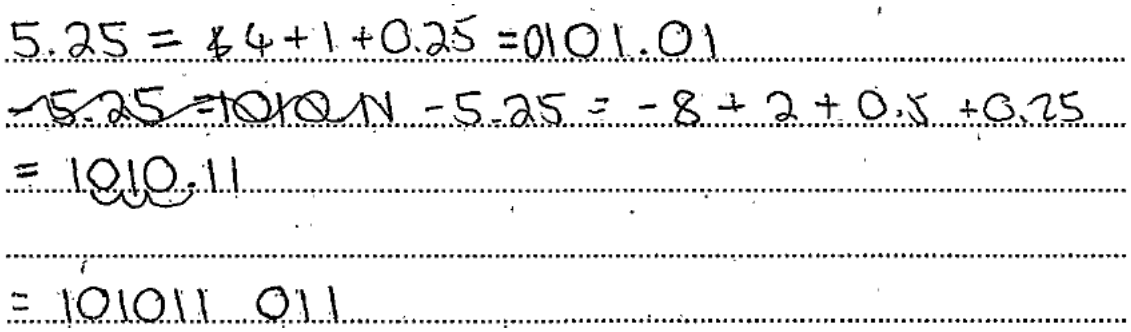
Exemplar 2

The candidate demonstrates a basic knowledge of the effect of computers on the environment; the material is basic. The candidate makes a limited attempt to apply knowledge and understanding. The candidate provides a limited discussion which is narrow in focus. This response is therefore a low level response. It was placed at the top of the low band since there was a level of accuracy albeit unsubstantiated.

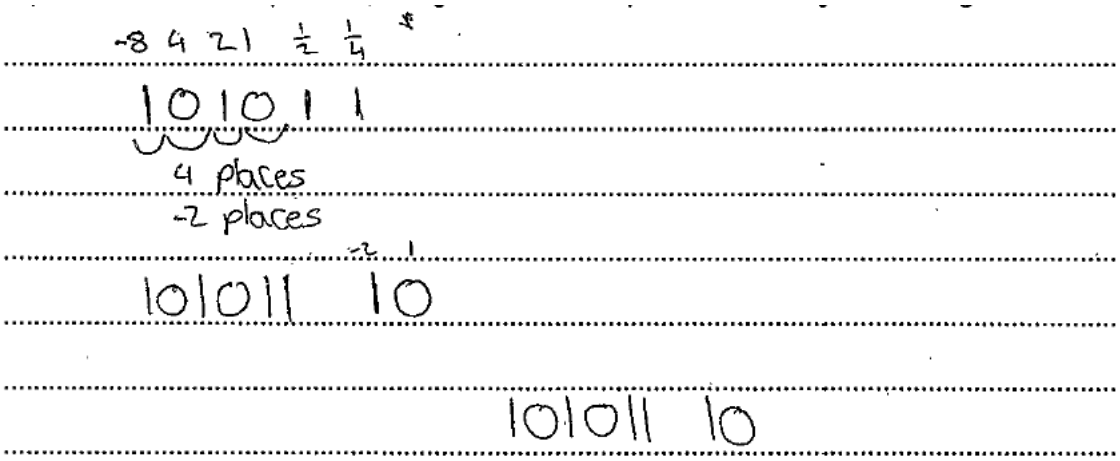
Question 10(f)

(f) Show the denary number −5.25 in floating point binary form representing the mantissa and exponent in two's complement, using as few bits as possible. Show your working. **[4]**

Exemplar 1 — 4 marks



Exemplar 2 — 2 marks



Examiner commentary

Candidates should be practised at showing their workings in these type of questions. Examiners are looking for the fixed point representation, evidence of the mantissa, showing the implied point and the number (and direction) of places the point has to float, the exponent.

In Exemplar 1, line four correctly shows the fixed point representation and the number of places the point must move to its correct implied position in the mantissa. On line six, the candidate has written the resultant floating point binary representation. Hence, achieving full marks.

In Exemplar 2, the response correctly showed the fixed point representation (headings provided evidence of understanding) hence the correct mantissa. The exponent or number of positions the implied binary point needs to 'float' was incorrectly demonstrated therefore the response achieved 2 marks.

Question 11(a)

11 A web development company makes its money building websites for other companies.

(a)* The web development company is looking to recruit a programmer to build websites.

Discuss the technologies the programmer would need to know and use and the importance of each one. **[9]**

Exemplar 1 — 8 marks

HTML, CSS, JS, SQL, PHP 24

A web development company makes its money building websites for other companies.

(a)* The web development company is looking to recruit a programmer to build websites.

Discuss the technologies the programmer would need to know and use and the importance of each one.

They would need to know HTML in order to create the basic structure of the GUI of the site. They would also need to know CSS in order to customise the website to make it aesthetic easy to use and to the ~~company~~. Companies ~~likeing~~ liking. The developer must also be familiar with Javascript So client side processing can be done to make the site interactive as well as able to check for errors. PHP would also have to be known for server side processing and validation. In addition the programmer would need to be confident with SQL so that user logins can be ~~implemented~~ saved to a data base. It may also be needed to store transactions and prices if the site has an online shop. The transactions themselves would likely be handelled by a server-side language (PHP). **[9]**

ALL in all, each is needed since all of them do ~~important~~ important things for the wep-page.

Examiner commentary

Again with this extended response question, candidates should be encouraged to carefully plan their answer to cover all elements of the question.

In the exemplar, the candidate has demonstrated a thorough knowledge of the technologies required for web development. The response gives an account that addresses a range of ideas and arguments of the technologies a programmer needs to know and use to build websites, outlining the importance of each. The exemplar response addresses most of the indicative content, applying their knowledge with relevant examples, e.g. SQL for interacting with a user login database.

This response was given eight marks, mid high band. It was felt that the evaluative comments could have been further developed but it still deemed a high level response.

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